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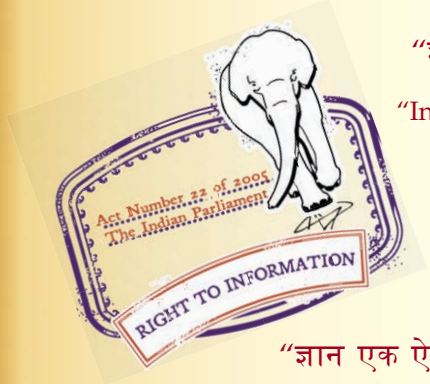
IS 10242-5-3 (1993): Electrical installations in ships, Part 5: Special features, Section 3: ac supply system with voltage in the range above 1 kV up to and including 11 kV [ETD 20: Electrical Installation]



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जहाजों में विद्युत संस्थापन — विशिष्टि

भाग 5 विशेष लक्षण

अनुभाग 3 ए सी 1 कि वा से 11 कि वा तक के रेंज में वोल्टताओं के साथ ए सी पूर्ति

Indian Standard

ELECTRICAL INSTALLATIONS IN SHIPS — SPECIFICATION

PART 5 SPECIAL FEATURES

Section 3 ac Supply Systems with Voltages in the Range Above 1 kV Up to and Including 11 kV

UDC 629·12·066 : 621·316·174 : 621·311·6

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BUREAU OF INDIAN STANDARDS
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Price Group 3

FOREWORD

This Indian Standard (Part 5/Sec 3) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electrical Equipment and Installations in Ships and Offshore Structures Sectional Committee had been approved by the Electrotechnical Division Council.

This standard (Part 5/Sec 3) is one among the series of the Indian Standards on electrical installations in ships. This series will have the following parts:

Part 1 General,

Part 2 System design,

Part 3 Equipment,

Part 4 Installation and test of completed installations, and

Part 5 Special features.

In preparing this standard, assistance has been taken from the IEC Publication 92-503 (1975). 'Electrical installations in ships : Part 503 Special features — A.C. supply systems with voltages in the range above 1 kV up to and including 11 kV', issued by the International Electrotechnical Commission.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

ELECTRICAL INSTALLATIONS IN SHIPS — SPECIFICATION

PART 5 SPECIAL FEATURES

Section 3 ac Supply Systems with Voltages in the Range Above 1 kV Up to and Including 11 kV

1 SCOPE

This standard (Part 5/Sec 3) covers supply systems with voltages from 1 kV up to 11 kV. The requirements contained in other part of IS 10242 apply where appropriate, subject to the exceptions stated in the following clauses.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

SECTION 3A GENERAL

3 VOLTAGE AND FREQUENCY

3.1 Voltage and frequency should be chosen in accordance with Table 2 and 4 of IS 12360 : 1988. The values applicable for ship's service systems are:

Nominal System Voltage[1]	*Nominal Frequency*
kV	Hz
3	
3·3	
6	50 or 60
6·6	
10	
11	

[1] Value between phases.

4 INSULATION LEVEL

4.1 The conditions on board ships may require certain equipment having an insulation level higher than that of the nominal voltage of the system [*see* IS 2165 (Part 1) : 1977 and IS 2165 (Part 2) : 1983].

This should be agreed between the manufacturer and the purchaser.

SECTION 3B ARRANGEMENT OF NETWORKS

5 DISTRIBUTION

5.0 The following systems are recommended:

— 3-phase, 3-wire insulated; and

— 3-phase, 3-wire neutral earthed.

This system is further classified as:

a) Earthed with high resistance;

b) Earthed with low resistance; and

c) Earthed directly.

The main switchboard should be in at least two independent sections, so arranged that essential services may be operated even in case of fault in one section of the switchboard.

5.1 Treatment of Neutral Point

5.1.1 *Insulated Neutral Systems*

For insulated neutral systems, attention is drawn to the likelihood of transient overvoltage to earth being higher than on an earthed neutral system and special consideration should be given to the dielectric strength insulation.

5.1.2 *Directly Earthed Neutral Systems*

Where neutrals are directly earthed, it should be ascertained that the equipment can withstand the earth-fault current which may result from a single-phase earth-fault. If means are provided for limiting earth-fault currents, this should not influence selectivity.

NOTE — If an impedance (resistance or reactance) is connected between the neutral point of the system and earth, then on the occurrence of an earth-fault, the induced overvoltage will be higher than will be the case with direct neutral earthing.

5.1.3 *Divided System*

Where an earthed system is divided into two or more sections, means for neutral earthing should be provided for each section.

5.2 Generator and Transformer Neutrals

5.2.1 *Generator Neutrals Interconnected*

If generators are intended to run with neutrals interconnected, manufacturers should be informed so that the machines can be suitably designed

to avoid excessive circulating currents. This is particularly important if they are of differing size and make.

5.2.2 *Disconnection*

Means of disconnection should be fitted in the neutral earthing connection of each ac generator so that the generator may be disconnected for maintenance.

NOTE — Transformer neutrals at the higher voltage side should not be earthed unless all the ac generators are disconnected from the system (for instance, during shore supply).

5.3 Control Voltage

If an independent means of supply is required for control purposes, it should be at a voltage not higher than 220 V.

SECTION 3C ac GENERATORS AND MOTORS

6 ENCLOSURES

6.1 The degree of protection should be at least in accordance with Class 23 of IS 4691 : 1985, but for terminals at least Class IP 44.

For motors installed in spaces accessible to unqualified personnel, a degree of protection against contact with live or moving parts at least in accordance with Class IP 4x is recommended.

6.1.1 *Performance*

6.1.1.1 *Temperature monitoring*

If embedded temperature detectors are used, means should be provided to protect the circuits from stray voltages. It is recommended that for each phase, a spare set of temperature detectors be provided with terminals suitably brought out.

6.1.2 *Stator Winding Circuit Arrangement*

Generator stator winding should have all phase ends brought out.

6.1.3 *Generator Performance at Transformer Switching*

The performance of generators with excitation influenced by inrush current for the switching-on of large transformers should be agreed upon by the manufacturer and the purchaser (*see also* **7.3**).

6.2 De-excitation

The excitation system should be so designed that a faulty generator will be de-excited automatically.

6.3 Mechanical Characteristics

6.3.1 *Accumulation of Moisture and Condensation*

Effective means should be provided to prevent accumulation of moisture and condensation within the machines especially when they are idle for appreciable periods, for instance by means of space heaters.

6.3.2 *Water Coolers*

Means for easy inspection of water cooler leakage should be provided as well as indication of leakage by alarm. Consideration should be given to the use of double tubes in water coolers.

6.3.3 *Terminals*

Higher-voltage terminals of rotating machinery should never be combined with lower-voltage terminals in the same box, unless measures have been taken to ensure that access to lower voltage terminals can be obtained without danger.

Terminals of motors should be arranged in terminal boxes and, wherever practicable, all conductors should be effectively covered with suitable insulating material. If the conductors are not insulated, phases should be separated from earth and from each other by substantial barriers of suitable insulating material. Adequate space should be provided to facilitate efficient cable terminations.

SECTION 3D TRANSFORMERS

7 SCOPE

7.0 This section applies to power transformers, reactors and neutral earthing transformers in accordance with IS 2026 (Parts 1 to 4), IS 5553 (Parts 1 to 8) and IS 3151 : 1982 respectively.

7.1 Construction

7.1.1 *Enclosures and Installations*

When installed in spaces accessible only to qualified personnel, transformers and reactors, together with their enclosures should have at

least a degree of protection in accordance with Class IP 23 of IS 2147 : 1962.

For transformers and reactors installed elsewhere, the degree of protection should be at least in accordance with Class IP 54 of IS 2147 : 1962.

Alternatively, where transformers are not contained in an enclosure but a transformer room forms the enclosure of the transformer, the door of the room is to be interlocked with the supply switchgear.

7.1.2 *Reactors and Transformers*

Effective means should be provided to prevent accumulation of moisture and condensation within the reactors and transformers especially when they are idle for appreciable periods, for instance, by means of space heaters.

7.1.3 *Vector Group*

Attention is drawn to the fact that difficulties may be experienced if transformers are connected star/star. These difficulties will be associated with earth-fault conditions and third harmonics. In all such cases, adequate safeguard should be made in the design.

7.2 Transient Voltage Conditions

When the largest consumer on the lower voltage side is switched on, this voltage should not drop below 85 percent of the nominal voltage.

NOTE — Attention is drawn to the voltage change characteristics of generators [*see* 10.3 and Note to 6.2 of IS 10242 (Part 3/Sec 1) : 1983].

7.3 Current Inrush

Special attention should be paid to the current inrush and as a consequence voltage dip at the primary side when transformers are switched on. This is particularly the case when a second transformer is being switched in parallel or when the relationship between the ratings of generator and transformers is not compatible. Means for reduction of current inrush should be considered if necessary.

NOTE — In the absence of transformer characteristics, the asymmetrical peak value of the current inrush should be considered to reach a maximum value up to 15 percent after the first half-cycle.

SECTION 3E SWITCHGEAR

8 GENERAL

8.1 Switchgear should be of the metal-enclosed type in accordance with IS 3427 : 1969 or of the insulation-enclosed type.

NOTE — Attention is drawn to the fact that the normal service conditions for insulation-enclosed switchgear includes a maximum ambient temperature of 45°C, and that consequently the switchgear should have a thermal stability for ambient temperature.

9 ENCLOSURES

9.1 a) For metal-enclosed and insulation-enclosed switchgear, the degree of protection of persons against hazardous approach to live parts should be at least in accordance with IS 3427 : 1969.

b) For metal-enclosed and insulation-enclosed switchgear, the degree of protection against ingress of liquid should be at least in accordance with class IP2x of IS 2147 : 1962.

10 CIRCUIT-BREAKERS, SWITCHES AND FUSES — GENERAL

10.1 Circuit breakers and switches should be of such a type that minimum fire hazard is ensured.

10.2 Circuit-breakers should be in accordance with relevant parts of 13118 : 1991 [IEC Pub 56 (1987)] and IS 13947 (Part 2) : 1993 [IEC Pub 947-2 (1989)]. For the selection of circuit-breakers attention is drawn to IS 9385.

10.3 Switches should be in accordance with IS 9902 : 1988.

10.4 Fuses should be in accordance with relevant parts of IS 9385 High voltage fuses [*see also* IS 10242 (Part 3/Sec 2) : 1984], the use of fuses for overload protection is not admissible.

10.5 Conduit pipes and valves of compressed-air operating mechanisms should be of non-corrosive material.

10.6 If compressed-air-operated circuit-breakers are used, the compressed-air system should be so designed that switching on is possible only if sufficient switch-off pressure is available for every circuit-breaker on the same compressed-air system. Loss of air pressure should be indicated audio visually.

10.7 In a compressed-air system, means should be present to provide clean and dry air. These means should be duplicated to allow maintenance.

10.8 Circuit breakers should be of the withdrawable type or with equivalent means or arrangements permitting safe maintenance whilst the busbars are live.

10.9 Withdrawable circuit-breakers and switches should be provided with mechanical locking facilities in both service and disconnected

positions. For maintenance purposes, key-locking withdrawable circuit-breakers and switches and fixed disconnectors should be possible.

11 EARTHING AND SHORT-CIRCUITING

11.1 For maintenance purposes, an adequate number of earthing and short-circuiting devices should be available to enable a sufficient number of circuits to be worked upon with safety. Alternatively, integral means of earthing and short-circuiting may be fitted.

12 PROTECTION AGAINST LIVE PARTS

12.1 The fixed contacts of withdrawable circuit-breakers and switches should be so arranged that in the withdrawn position the live contacts are automatically covered or full withdrawal is possible only after manual insertion of covers.

13 AUXILIARY SYSTEMS

13.1 If electrical energy and/or physical energy is required for the operation of circuit-breakers and switches, a stored supply of such energy should be provided for an adequate number of operations.

SECTION 3F ELECTRICAL PROTECTION

14 GENERAL

14.1 In addition to the recommendations of IS 10242 (Part 3/Sec 2) : 1984 the following clauses apply.

15 GENERATOR PROTECTION

15.1 The faults on the generator side of the circuit-breaker referred to in IS 10242 (Part 3/ Sec 2) : 1984 is in this connection, regarded as phase-to-earth. Consideration should also be given to phase-to-phase and interwinding faults.

16 MOTOR PROTECTION

16.1 When a single consumer, such as a bow thruster, is supplied directly at a higher voltage via a step-up transformer, the protection on the lower-voltage side of the transformer will be considered adequate.

17 POWER TRANSFORMER PROTECTION

17.1 For short-circuit protection at the primary side, circuit-breakers are preferred. If fuses are used, attention is drawn to IS 10242 (Part 3/ Sec 2) : 1984.

17.2 If the total connected load of all outgoing circuits on the secondary side exceeds the rated load, consideration should be given to an overload protection or to an overload alarm being provided.

17.3 When transformers are connected in parallel, tripping off the protective device at the primary side should automatically trip the switch connected at the secondary side.

18 EARTH-FAULT MONITORING

18.1 Means of indicating by alarm any earth fault in the system should be fitted. In a neutral earthed system, such an indication may be omitted where selective tripping is provided.

19 VOLTAGE-TRANSFORMER PROTECTION

19.1 Voltage transformer should be protected against short-circuit by fuses on the primary and on the secondary sides. Consideration may be given to omitting fuses on the primary side, subject to agreement between the manufacturer and the purchaser.

SECTION 3G CABLES, INSTALLATIONS, CONDUCTORS AND TERMINATIONS

See relevant sections of IS 10242 (Part 3).

ANNEX A

(*Clause* 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
2026 (Part 1) : 1677	Power transformers : Part 1 General (*first revision*)
2026 (Part 2) : 1977	Power transformers : Part 2 Temperature rise
2026 (Part 3) : 1981	Power transformers : Part 3 Insulation level and dielectric tests (*second revision*)

IS No.	*Title*
2026 (Part 4) : 1977	Power transformers: Part 4 Terminal marking tappings and connections (*first revision*)
2147 : 1982	Specification for degrees of protection provided by enclosures for low voltage switchgear and controlgear
2165 (Part 1) : 1977	Specification for insulation coordination: Part 1 Phase to earth insulation coordination
2165 (Part 2) : 1983	Specification for insulation coordination: Part 2 Phase to phase insulation coordination principles and rules
3427 : 1969	Metal-enclosed switchgear controlgear for voltage above 1 000 V but not exceeding 1 000 volts
4691 : 1985	Specification for degrees of protection provided by enclosure for rotating electrical machinery (*first revision*)
5553 (Part 1) : 1989	Reactors: Part 1 General
5553 (Part 2) : 1989	Reactors: Part 2 Shunt reactors
5553 (Part 3) : 1989	Reactors: Part 3 Current limiting reactors and neutral earthing reactors
5553 (Part 4) : 1990	Reactors: Part 4 damping reactors
5553 (Part 5) : 1990	Reactors: Part 5 Tuning reactors
5553 (Part 6) : 1991	Reactors: Part 6 Earthing transformers (Neutral couplers)
5553 (Part 7) : 1990	Reactors: Part 7 Arc supression reactors
5553 (Part 8) : 1990	Reactors: Part 8 Smoothing reactors
9385	High voltage fuses
9902 : 1982	Recommended practice for leak testing
10242 (Part 3/ Sec 1) : 1983	Electrical installations in ships: Part 3 Equipment, Section 1 Generators and motors
10242 (Part 3/ Sec 2) : 1984	Electrical installations in ships: Part 3 Equipment, Section 2 Switchgear and controlgear assemblies
12360 : 1988	Specification for voltage bands for electrical installations including preferred voltages and frequency (superseding IS 585)
13118 : 1991 IEC Pub 56 (1987)	High-voltage alternating-current circuit-breakers
13947 (Part 2) : 1993 IEC Pub 947-2 (1989)	LV switchgear and controlgear: Part 2 circuit breakers [superseding IS 2516 (Parts 1 & 2/Sec 1): 1985]

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